Postnatal fetal and adult hemoglobin synthesis is preterm infants whose birth weight was less than 1,000 grams.

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Postnatal Fetal and Adult Hemoglobin Synthesis in Preterm Infants Whose Birth Weight Was Less Than 1,000 Grams

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Abstract To determine if environmental factors could effect the switchover from fetal hemoglobin (HbF) to adult hemoglobin (HbA) synthesis, studies were carried out on blood samples from eight infants born at <1,000 g, when they had reached their postconceptional age corresponding to term. All of these infants required prolonged intensive care, multiple blood transfusions, and two required exchange transfusions. Several were ventilated mechanically for 60 d and two infants had bronchopulmonary dysplasia at the time of the study. The blood samples were incubated in an amino acid mixture containing [14C]leucine followed by column chromatography on DEAE Sephadex for separation of radioactive HbA and HbF. In spite of the extreme prematurity and poor growth of these sick infants, the proportional synthesis of HbF and HbA, as determined by the incorporation of [14C]leucine during the erythrocyte incubations, was characteristic of the period of human development from which the erythrocytes were obtained.

Introduction Recent developments in clonal cell culture methods for early erythropoietin precursors have made it possible to study hemoglobin synthesis in culture in relation to the stages of maturation of the human erythrocyte precursors (1, 2). Based on these studies it has been suggested that the regulation of fetal hemoglobin (HbF) is inversely related to the degree of differentiation of the human erythroid cells known as burst-forming units. Also from these studies it has been suggested that the switch from HbF to adult hemoglobin (HbA) as development proceeds can be explained by the derivation of erythrocytes from progressively more differentiated burst-forming units and the reappearance of HbF under pathological conditions by the

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1 Abbreviations used in this paper: HbA, adult hemoglobin; HbF, fetal hemoglobin.
The infant’s blood contained 28.9% HbF and 71.1% HbA. However, the synthesis was 57.4% HbF and 42.6% HbA. This was the expected proportions at 40.5 wk postconceptional age.

The comparison of the data on HbA and HbF synthesis to what has been published previously (6) is shown on Fig. 3. This figure illustrates that these very low birth weight infants who required prolonged intensive care have synthesis HbA and HbF in normal expected proportions when evaluated at the postconceptional age corresponding to term.

FIGURE 1. The distribution of the infants < 1,000 g at birth (○) and on the day of sampling (○), on the Colorado intrauterine growth chart (3). Solid lines represent the 90th and 10th percentiles.

A representative hemoglobin elution is shown on Fig. 2. This infant required two exchange transfusions (at 2 and 3 d of age) because of hyperbilirubinemia. The infant’s blood contained 28.9% HbF and 71.1% HbA. However, the synthesis was 57.4% HbF and 42.6% HbA. This was the expected proportions at 40.5 wk postconceptional age.

TABLE I
Therapy and Morbidity of the Infants < 1,000 Grams at Birth

<table>
<thead>
<tr>
<th>Weight of infants at birth</th>
<th>Number of transfusions packed cells (or whole blood) 10-20 cm³</th>
<th>Number of exchange transfusions</th>
<th>Parenteral nutrition</th>
<th>Assisted ventilation</th>
<th>Broncho-pulmonary dysplasia</th>
<th>Weight day of sample</th>
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</thead>
<tbody>
<tr>
<td>g</td>
<td>d</td>
<td>d</td>
<td>g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>2</td>
<td>14</td>
<td>d</td>
<td>d</td>
<td></td>
<td>1,980</td>
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<tr>
<td>860</td>
<td>2</td>
<td>14</td>
<td>2</td>
<td></td>
<td></td>
<td>2,230</td>
</tr>
<tr>
<td>980</td>
<td>3 (1)</td>
<td>2</td>
<td>9</td>
<td></td>
<td></td>
<td>1,220</td>
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<tr>
<td>730</td>
<td>6 (1)</td>
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<td>2</td>
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<td></td>
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<tr>
<td>820</td>
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<tr>
<td>945</td>
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<td>1</td>
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<td>2,000</td>
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<tr>
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<td>19 (1)</td>
<td>54</td>
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<td>1,500</td>
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</table>

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DISCUSSION

This study aimed to answer the question whether sick infants <1,000 g who were born prematurely and exposed to numerous stresses would have an altered pattern of fetal and adult hemoglobin synthesis. Previously it had been shown that preterm infants born at <32 wk of gestation had a rate of transition from HbF to HbA synthesis postnatally that is similar to the fetal switchover in utero (4). That earlier study was completed 10 yr ago when the neonatal intensive care unit had very few survivors at <28 wk of gestation and those that did survive were the infants that had minor or no neonatal complications. Thus, most of the data obtained at the end of that previous study were from normal infants that survived and were born near 32 wk of gestation.

At the present time the incidence of survival rate of preterm newborn infants <1,000 g is near 50%. However, these infants require a prolonged period of intensive care and often have the complications of pulmonary disease treated with assisted ventilation. They also need numerous blood transfusions as well as exchange transfusions and are initially nourished by total parenteral nutrition (intravenous amino acid and lipids). They are in many cases oxygen dependent for long periods of time and grow at a slower rate than the accepted intrauterine growth pattern (3).

The transition from HbF to HbA synthesis on the human fetus is precisely timed and coordinated during intrauterine life. The data from the present study indicate that the very immature sick preterm infant who survived the neonatal period, had erythroid cells that were producing the proportions of HbF and HbA that was characteristic of their postconceptional age. Therefore a very precocious and stressful exposure to the extrauterine environment does not effect the timing of the switchover from HbF to HbA synthesis.

ACKNOWLEDGMENT

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REFERENCES


